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Introduction of Recent Trend in EV and battery System

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ABSTRACT: Now a day we are going towards for reduction of global warming so we are focusing on non convectional energy resources for the reduction of carbon content in environmental . in India transportation system is major source of carbon production . This paper provide an overview of the recent work of electric vehicle in the region. The paper describes the development and the comparison of different part of components. The major components in battery technology, charger design, motor, steering and braking are examined. The global pollution is on rise and every effort made, being to reduce the CO2 emissions and save the planet. One such effort is the introduction of Electric Vehicles (EV). The transport sector is one of the biggest emitter of CO2 and hence it is very important to convert the sector to a green sector.

KEYWORDS: Electrical Vehicle, Motor, Battery etc

I. INTRODUCTION

Electrical vehicle (EV) based on electric propulsion system. No internal combustion engine is used. All the power is based on electric power as the energy source. The main advantage is the high efficiency in power conversion through its proposition system of electric motor. Recently there has been massive research and development work reported in both academic and industry. Commercial vehicle is also available[1]. It has been used extensive in the last few years. Nearly all the car manufacturers have at least one model in hybrid electric vehicle.

II. COMPONENT OF EV

The electric vehicle is rather simple in structure. The main components are battery , ultra capacitor, AC/DC inverter & Traction system . Fig.1 represent the Block diagram of Electrical vehicle..

The battery is the main energy storage. The battery charger is to convert the electricity from mains to charge the battery [3]. The battery voltage is DC and I is inverted into switched-mode signal through AC/DC inverter to drive the motor. The other electronic components in a vehicle can be supplied to the battery through DC-DC converter(Chopper Circuit) that step down the voltage from the battery pack to lower voltage such as 5V-20V.

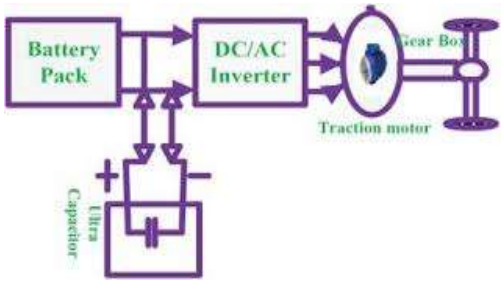

Figure.1: Block diagram of an Electric Vehicle.

III. THE MOTOR

Motor is the machine that convert the electrical power into mechanical power it is based on the principal of electromagnet induction. There are a number of motors available for electric vehicle:

- DC motors
- Induction motor
- DC brushless motor
- Permanent magnetic synchronous motor
- Switched reluctance motor.

A . DC motors:

In dc motor all the power involved in electromechanical conversion is transferred to the rotor through stationary brushes which are in rubbing contact with the copper segments of the commutator. It requires certain maintenance and has a shorter life time. DC motor are two types .

- Self excited DC motor
- Separately excited DC motor

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However, it is used as per requirement in Traction system like DC series motor is used with heavy duty load [2-3].

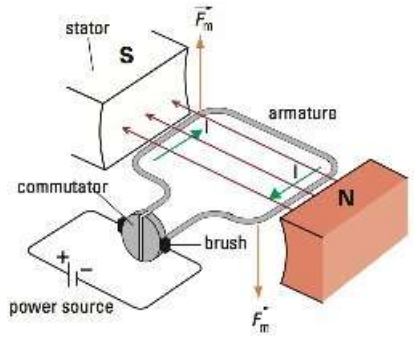

Figure.2: Simple layout of DC Motor.

B . Induction motor:

It is a very popular AC motors . An induction motor (also known as an asynchronous motor) is a commonly used AC electric motor. In an induction motor, the electric current in the rotor needed to produce torque is obtained via electromagnetic induction from the rotating magnetic field of the stator winding. The rotor of an induction motor can be a squirrel cage rotor or wound type rotor. Usually a vector drive is used to provide torque and speed control[4].

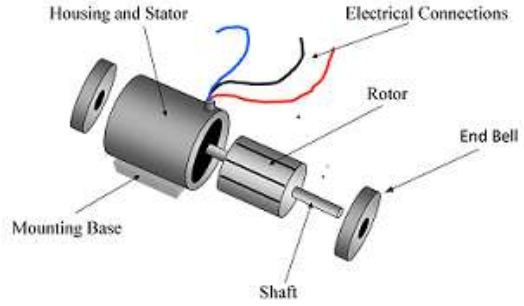

Figure.3: Simple layout of Induction Motor.

C. DC brushless motor:

The conventional DC motor is poor mechanically because the low power winding, the field, is stationary while the main high power winding rotates. The DC brushless motor is "turned inside out [5]-[6]. The high power winding is put on the stationary side of the motor and the field excitation is on the rotor using a permanent magnet. The motor has longer life time than the DC motor but is a few times more expensive. Most of the DC motor can be replaced by the brushless motor with suitable driver. Presently, its applications find in low power EV.

D. Permanent magnetic synchronous motor:

The stator is similar to that of an induction motor. The rotor us mounted with permanent magnets. It is equivalent to an induction motor but the air-gap filed is produced by a permanent magnet. The driving voltage is sine wave generated by Pulse Width Modulation (PWM).

E. Switched reluctance motor:

It is a variable reluctance machine and its famous recently because of the fault tolerance because each phase is decoupled from other. The power stage is different from other the motor discussed in 2-4. Each phase winding is connected in a fly back circuit style [7].

IV. ENERGY STORAGE

4.1. Batteries:

The battery is the main energy storage in the electric vehicle. The battery in-fact governs the success of the electric vehicle [9]. Recently there are massive works being reported in battery development. The battery such as Li-ion is now being used by new generation of electric vehicle. The danger of the instability of the battery has been studied by many reported. It seems that the LiFePO4 type is preferable because of its chemically stable and inherently safe. Other Li-ion such as LiCoO2, LiMn2O4 and Li(Ni1/3Mn1/3Co1/3)O2 may has the thermal and overcharge concern [10]. For low cost solution, the lead-acid battery is still dominant part of the market. The battery has found applications in electric wheel chair, Golf-cart, micro-car and neighborhood town air. The recent RoHS has also stopped the use of NiCd battery[5].

All the research is looking towards the fast charging for batteries. MIT reported [11] the technology of a crystal structure that allows 100 times of charging speed than conventional Li-ion battery. Other alternative is to use ultra-capacitor.

The battery cell forms the basic unit of the battery pack that is employed in the EVs. The battery cells together constitute a module and several such modules collectively form a battery pack. The batteries form the major cost in EVs. Their cost is nearly half of the cost of EVs. Hence, if the cost of batteries brought down, then cost of EVs will come down. The prices of electrodes and electrolytes needs to bring down to affordable prices. The research on battery cell involves increased thermal protection, higher power density, increasing the lifespan and coming with lightweight materials.

There are various battery technologies available for EVs. They are summarize as follows:

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a)Lead-acid Battery: These batteries employ lead oxide as positive active material; spongy lead as negative active element and sulphuric acid used as the electrolyte medium. The advantaged of lead-acid batteries are that are very commonly available and cost very less. The technology has been around fifty years and has matured now. The disadvantages are that they have a limited life cycle and low power density. They also weigh heavier.

b)Nickel-Metal Hydride Battery: These batteries carry nickel hydroxide as positive electrode and titanium or nickel as negative electrode. The electrolyte solution is alkaline solutions. These batteries are resistant to wide temperature changes and their life cycle are long. They are also recyclable. However, they suffer from lower charge-discharge cycles[6].

c)Lithium ion (Li-on) Battery: Currently the lithium ion (Li-on) batteries developed for running the EVs. There are three main variants of Li-on batteries. They are

i)NMC(Lithium Manganese Cobalt Oxide)
These batteries employ graphite as anode. NMC batteries very commonly used because of less cost. The other features of the battery is that they carry the highest specific energy and they are lightweight. This gives a significant edge over other variants. The disadvantage with these batteries are that they cannot be charged very fast (less than an hour) and typically requires 6 hours of charging time for normal usage of EVs. They also cannot exposed to ambient temperature of 40 degrees or above. These batteries carry 80% DoD and last up to 2500 charge-discharge cycles. The normal discharge rate of battery is 2 hours.

ii) LTO (Lithium Titanate) The LTO batteries can address the disadvantages of NMC batteries. These batteries can be charged fast (less than 30 minutes) and they are resistant to high ambient temperatures of 45 deg. They also can last up to 10000 charge-discharge cycles and hence they seem to be a very attractive. However, the downside of the LTO batteries are that that specific energy is lesser than NMC and they weigh more. However, there cost that is the main disadvantage. They cost around 3 to 4 time higher than NMC.

iii) LFP (Lithium Phosphate) The LFP batteries occupy an intermediate position between the NMC and LTO batteries. Compared to NMC batteries,there are more temperature tolerant, but lesser than LTO. They can also charge and discharge faster. India's approach towards battery cell should be a collaborative research with the global players and not entirely on its own. Many countries such US, Japan, China, Korea have advanced battery technologies and hence it will be wiser for India to collaborate with them. This can be done by many ways. One way is to let the global players invest their infrastructure in India. This will help the country in gaining the needed much knowledge in battery technology. Another way is to let the OEMs (Original Equipment Manufacturers) and national labs to collaborate with global players. In either way, the need for India is to scale up the battery manufacturing on quantity scale

4.2 Ultra-capacitor:

Capacitor is basically a static component. There is no chemical reaction in the components. Its charging and discharging speeds are very fast. However, the energy storage is limited. Its energy storage density is less than 20% of the lead-acid battery. Although the expected ultra-capacitor density will go up in next few years, its total solution for main energy storage is a challenge. The number of cycles and the temperature range is excellent[10].

Table 1: Comparison of different energy storage unit

	Lead acid	NiMH	Li Ion	Ultra Capacitor
Energy density whr /kg	40	70	110	5
Cycle life	500	800	1000	500000

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Working temperature(c)	-30 +50	-40 +50	-40 +60	-40 +85
Cost $/kWhr	1000	2400	5000	50000

Therefore ultra-capacitor is useful for fast speed or transient energy storage. As it allows high current charging, its charging time can be shortened to within a few minutes. The ultra-capacitor is still in the initial stage of development. It is expected that the cost will be going down and the energy density will go up rapidly in next few years**.**

4.3. Charging Infrastructure:

At present, India needs to provide adequate charging infrastructure to boost the adoption of EVs by Indian customers. The lack of charging infrastructure will put the customers under range anxiety, as the vehicle may not run long without charging infrastructure at regular intervals on the roadways. Charging infrastructure classified into following:

Home Charging:

This is the most common type of charging. The customer needs to have a 230V/15 A single phase supply in order to charge the EVs. They can deliver a maximum of 2.5 KW. The charging process takes time and it is expect that the customers will charge the EVs at night. The metering is connect directly with home metering and hence there is no separate billing for it. However, there may be soon a policy emerge to regulate the home charging also with separate metering and guidelines for builders to mandatorily include EV charging stations in flats and apartments[8].

Public Charging:

Public charging maintained by the government or its any of delegated bodies. Public places such as parking lots, malls, offices may be target to offer public charging. They are meter separately.

a)AC Charging: AC charging can be a slow or fast charging. They will employ a power converter to convert the ac power into dc power to charge the batteries. The slow charging will charge at 2.5 kW to 3 kW while fast charging will charge at the rate of 7.7 kW to 22 kW. The IEC 60309 Industrial Blue connector prescribed as the Bharat EV standard to be use in AC charging.

b) DC Charging: In this method, the output of the charging port directly provides high current DC power to directly fed to the batteries. The charging rates are very high upto 50 kW. The voltage rating of them is 48V/72V. DC fast charging infrastructure is very important for buses and cabs, which usually travel long distances.

4.4. Battery Management System:

Battery Management System (BMS) is the electronics that deals with binding the cells of a battery pack together and constantly monitoring the status of each cell. The temperature of each cell, charge-discharge status, short circuit protection.

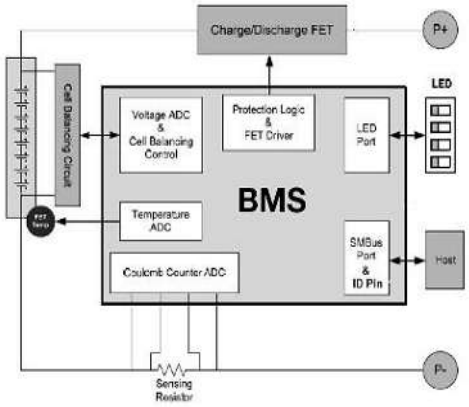

Figure.4: Schematic Diagram of BMS

carried out by BMS. The BMS leads to efficient use of the battery pack. The BMS is highly dependent on local weather conditions and hence it is very important of India to develop their own BMS rather than outsourcing them. An indigenous

BMS will keep in pace with the cost affordability of Indian Customers. An EV suitable for EU nations may not be suitable for Indian conditions because of the differences in the weather conditions. In this case, the BMS plays the key role to make the EV suitable for Indian weather conditions. Power electronics takes care of the various power conversion process from the plug to wheel. The various power electronics converters employed in EVs are

a) AC-DC converter: The EVs conventionally charged from an ac outlet. However, but the batteries charge only with dc power. Hence, the AC-DC converter helps in converting the ac power to dc power, not only batteries, dc power is required by many electronics loads such as lights, heater within the EVs and hence it is a big network of power[9].

b) DC-DC converter: The dc power from the AC-DC converter is often variable and fluctuating. Hence, it is necessary to make the dc power constant and stable. In a DC-DC converter, it is important to provide the isolation between input and
output. This makes sure that the power electronics converter are safe from any reverse flow of current.

c) DC-AC converter: The ac power is necessary to drive the electric motors in EVs. Hence, another DC-AC converter is necessary to convert the dc power from DC-DC converter to ac power. The ac power could be single-phase or three-phase depending upon the type of motor used.

d) AC-AC converter: This converter used for the purposes of changing the frequency of ac power. The electric motors. when required to operate with variable speed based on frequency could employ this converter There are wide areas of research in power electronics for use in EVs. The converters need to be compact and occupy very less space. This helps in providing more interior spacing within the vehicle; the converters also need to be lightweight. A heavier converter burdens the electric motors to carry more current to achieve high speed. The heat management in power electronics is also very important and process ventilation facility needs to provide**.**

V. CONCLUSION

This paper discusses the recent development in electric vehicle. The paper first describes general structure and discusses the energy storage. It then extends the comparative analysis of different type of battery used in EV. The paper provides an overview of the recent EV work and different type of in the region.

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